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# COMPARISON OF ACHIEVEMENT OF GRADE NINE STUDENTS IN SELECTED SINGLE GRADE AND MULTI-GRADE CLASSES IN ALBERTA

by

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A THESIS

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FACULTY OF GRADUATE STUDIES

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled "Comparison of Achievement of Grade Nine Students in Selected Single Grade and Multi-Grade Classes in Alberta," submitted by Lawrence Andrew Truckey in partial fulfilment of the requirements for the degree of Master of Education.

# ABSTRACT

This study investigates the relation between class organization, categorized by number of grades per room, and student achievement as measured by the Grade Nine Departmental Examinations, for the school year 1961-1962. Students were assigned to four categories as follows: (1) Group SG attended schools with all grade nine students in one room and the school contained one grade nine room, (2) Group DG attended schools with two grade nine rooms, (3) Group LMG attended schools with grade nine rooms where other lower, but not higher, grades were also taught, (4) Group HMG students attended schools with grade nine rooms where some high school grades were also taught.

Group SG is also termed the single grade group; group DG, the double-grade group; group LMG, the lower multi-grade group; and group HMG, the higher multi-grade group.

Data were obtained from the School "A" cards and from the official examination records of the Alberta Department of Education. The statistical method of data analysis was by analysis of variance, followed by the t-test, when appropriate. The mean level of ability was equalized by randomly casting out cases in the required groups. The number of cases used are as follows, with the number before casting out contained in parenthesis: group SG (3,835) 2,799; group DG (1,151) 850; group LMG (727) 597; and the HMG (242) 242.

The major problem investigated was the relationship between composite student achievement in the six Grade Nine examination subjects

and class organization of the four categories. The F-test showed significance at the .10 level. The F-test was followed by a t-test applied to the groups taken two at a time. The SG or single-grade group was found to have achieved significantly better than the LMG or lower multi-grade group, at the .05 level. The DG or double-grade group was found to have achieved significantly better than the LMG or lower multi-grade group, at the .01 level, and the SG or single-grade group, at the .10 level. The mean composite achievement of the HMG, or higher multi-grade group was not found to be significantly different from any of the other three groups.

When the F-test was applied to the individual subjects no significant difference was shown in the three areas, Reading, Social Studies, and Mathematics. Significance at the .01 level was found in three subjects using the F-test. These subjects were Literature, Language and Science.

In Literature, the double-grade or DG group students achieved significantly higher mean standings, than the single grade or SG groups students (.01 level), lower multi-grade or LMG students (.01 level), and the HMG or higher multi-grade students (.10 level). Single grade or SG students were also found to have achieved significantly higher mean standings than the LMG or lower multi-grade students.

The double-grade (DG) group also achieved significantly higher results in Language than did the single grade (SG) group (.05 level), the lower multi-grade (LMG group) (.01 level), and the higher multi-grade (HMG) group (.10 level). The single grade (SG) group achievement was significantly higher than lower multi-grade (LMG) achievement

(.01 level). The higher multi-grade (HMG) group also achieved significantly higher results in Language than did the lower multi-grade (LMG) group, at the .05 level.

The analysis of achievement in Science showed the double-grade (DG) group significantly higher than the single (SG) group (.05 level), the lower multi-grade (LMG) group (.01 level), and the higher multi-grade (HMG) group (.10 level).

In summary, double-grade (DG) students achieved significantly higher results in composite achievement and in Literature, Language and Science than did students in the lower multi-grade (LMG) and single-grade (SG) groups. Single-grade (SG) results were higher in composite achievement and in Literature, Language and Science, than lower multi-grade (LMG) achievement. In two cases, Language and Science, the higher multi-grade (HMG) group achieved significantly higher than the lower multi-grade (LMG) group. In no instance did the lower multi-grade (LMG) group achieve significantly higher than any of the other groups.

General conclusions which this study seems to justify are as follows: double-grade students achieve better results on the average than do students of the other three groups; single-grade students tend to achieve significantly higher results than do students of lower multi-grade classrooms; higher multi-grade and lower multi-grade students do not achieve at significantly different levels. Although single-grade students achieved higher results in more cases than did higher multi-grade students, the differences were not found to be statistically significant.

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# CHAPTER I

# THE PROBLEM

## I. THE SIGNIFICANCE OF THE PROBLEM

In several rural areas in Alberta there are small schools situated within distances which would seem reasonable as regards transportation of the students from the small schools to the centralized schools. Often, the County or Divisional School Boards in these areas would like to close the smaller schools (particularly Junior and Senior High levels), and transfer the students to the larger school. In many cases the small school community, and/or the Local District School Board are reluctant to have this done. This type of situation has caused problems ever since centralization began in Alberta, in the early 1940's.

Although many other advantages have been claimed for larger schools it is most frequently argued that the academic achievement of students in larger schools is better because there is only one grade taught in each classroom.

This study attempts to determine whether or not this argument is substantiated by achievement test results at the Grade Nine level. It is recognized that there are probably many other factors involved, however, the only relationship examined in this study is that of academic achievement and having been taught in a single-grade or multi-grade situation.

## II. PURPOSES OF THE STUDY

### Main Purpose

It is the purpose of this study to determine if any relationship exists between academic achievement and the classroom organization as regards number and level of grades being taught in one classroom.

### Sub-Purposes

A. One sub-purpose is to determine whether or not there is a significant difference in the composite academic achievement in the six examination subjects of Grade Nine students, in schools where there is one Grade Nine class and only Grade Nine students are in the classroom, in schools where there are two or more Grade Nine classes, in schools where Grade Nine is taught in the same classroom as other lower but not higher grades, and in schools where Grade Nine and one or more High School grades are taught in the same classroom.

B. A second sub-purpose is to find out if there is any significant difference in achievement in the separate subjects, of Grade Nine students in the four categories.

## III. LIMITATIONS

A. No attempt is made to determine the specific causes of differences in achievement, if any are shown. There are many factors which could be examined to determine their relationship to achievement in the four situations, however, this study ignores all factors except the classroom organization as regards number of grades in each classroom.

B. Only the six examination subjects are used as the basis for

measuring academic achievement.

## IV. DELIMITATIONS

The limitations for this study have been set as follows:

A. This study is restricted to the school year 1961-1962;

B. This study is restricted to rural areas in the Province of Alberta;

C. Only subjects in which Departmental Final Examinations are written are considered in this study.

## V. DEFINITIONS

### Academic Achievement

Academic achievement is that which is measured by the Grade Nine Departmental Examinations.

### Ability

Ability is that which is measured by the Grade Nine Departmental Ability Test.

### A Multi-Grade Situation

This is a school situation in which one or more other grades are being taught in the same room as the Grade Nine students.

### A Single-Grade Situation

This situation occurs when Grade Nine only is being taught in one room.

### Double-Grade Schools

These are schools where there are two grade nine rooms.

### Lower Multi-Grade Group

This group is composed of students taught in schools where one or more lower grades but not higher grades also receive instruction in the grade nine room.

### Higher Multi-Grade Schools

These are schools which teach one or more higher grades in the same room as the grade nine students.

### A Town

This is a settlement which is classified as a town by the Department of Municipal Affairs.

### A City

This is a settlement which is classified as a city by the Department of Municipal Affairs.

### Composite Achievement

This is the mean standing of a student in the six Departmental Examination subjects of Grade Nine.

## VI. ASSUMPTIONS

The assumptions for this study are as follows:

A. It is assumed that the Departmental Examinations do in fact measure academic achievement;

B. It is assumed that the Departmental Ability Test does in fact

measure academic ability;

C. It is assumed that the above-mentioned examinations are reliable;

D. It is assumed that the extra-school environments of the groups are not significantly different. That is to say, differences in achievement can be attributed to the school situation.

## VII. SOURCES, ORGANIZATION AND METHOD OF ANALYSIS

### Introduction

This section outlines the sources of information and discusses the population, as well as the four groups used. In addition, the method of analysis is explained.

### Sources

Data for this thesis were obtained from the Department of Education. Individual student cards and School "A" cards were the specific sources. Ability was controlled by equalizing mean ability by casting out cases and also by eliminating schools whose students had characteristics or environments obviously different from the majority. The data were analyzed by the method of analysis of variance.

Each year, every school in the Province completes a form "A" card which is sent to the Department of Education. This card contains information such as courses taught, organization of school per classroom, number of pupils per room and number of grades per room. It was by means of these cards that schools were classified into the four groups.

Once the schools were classified, the students in each group could

be identified. The marks achieved by the students were then obtained from the individual student cards kept by the Department of Education.

## The Population

The basic purpose in this study is to compare the academic achievement of students in multi-grade and single-grade situations. Since multi-grade situations occur only in rural areas it was decided to eliminate towns and cities from this study. A study by Eddy[1] shows that urban Grade Nine students achieve higher standings on Departmental Examinations than do rural Grade Nine students. It is hoped that by excluding towns and cities the extra-school environments of the students in the four groups are more nearly similar.

Separate schools are also excluded on the assumption that many of these schools may teach French, and/or Religion, and the resulting decrease in instructional time available might be an important factor affecting academic achievement in the six Departmental Examination subjects. It is also assumed that a relatively larger proportion of multi-grade schools would be in Separate schools than would be the case for single-grade schools.

In addition, some schools which were obviously different from the majority are excluded. These included three schools which, while not actually located in cities, are on the fringes of cities and whose students could not logically be considered rural. Indian schools and institutions maintained by correctional agencies are also excluded.

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[1] W. F. Eddy, "Teacher Characteristics and Grade IX Social Studies Achievement" (unpublished Master's thesis, University of Alberta, Edmonton, 1962).

All schools in the Province of Alberta not excluded above are used in this study. The students of these schools constitute the total population which is considered to be a sample of all of the students in these groups over a period of years. A list of schools used is contained in the appendix.

## Organization of The Population

Four groups of schools are used for purposes of this study. Two groups are formed from multi-grade schools and two groups are formed from the single-grade schools. The sub-groups of the single-grade group are called SG and DG groups. The SG or single-grade category includes those schools which have one and only one Grade Nine class which is taught in a classroom where no other grades are taught. The DG, or double-grade group includes those schools which have more than one Grade Nine class. The SG or single-grade group consists of 202 schools and 3,835 students and the DG or double-grade group consists of 28 schools and 1,151 students.

The sub-groups of the multi-grade are called LMG, or lower multi-grade group and HMG, or higher multi-grade group. The LMG, or lower multi-grade group consists of schools which have Grade Nine taught in the same classrooms as other junior high school grades, but not high school classes.

The HMG, or higher multi-grade sub-group is composed of schools which conduct some high school classes in the same room as the Grade Nine classes are held. The LMG sub-group is made up of 111 schools and 727 students. The HMG group contains 28 schools and 242 students.

A pictorial representation of the groupings follows.

| SINGLE-GRADE SCHOOLS | | MULTI-GRADE SCHOOLS | |
|---|---|---|---|
| GROUP SG<br>or<br>Single-Grade Group | GROUP DG<br>or<br>Double-Grade Group | GROUP LMG<br>or<br>Lower Multi-Grade Group | GROUP HMG<br>or<br>Higher Multi-Grade Group |
| Includes those schools which have one and only one Grade Nine class which is taught in a classroom where no other grades are taught | Includes those schools which have two Grade Nine classes | Consists of schools which have Grade Nine taught in the same classroom as other junior high school grades, but not high school classes | Consists of schools which conduct some high school classes in the same room as the Grade Nine classes are held |
| 202 schools | 28 schools | 111 schools | 28 schools |
| 3,835 students | 1,151 students | 727 students | 242 students |

## Source of Data

There are six examination subjects in Grade Nine in Alberta and the results students achieve on these examinations are considered the criteria for measuring academic achievement for the purposes of this study. The six subjects are Reading, Literature, Language, Social Studies, Mathematics and Science.

In each of the subjects, excepting Social Studies and Science, the individual record cards contain a raw score achieved on the examination and a transmuted score out of one hundred. A transmuted score is the score arrived at after the marks in a particular subject have been put on a scale to arrive at the distribution desired by the Department of Education. The students' relative position is not changed by this process, however, the percentage may be changed slightly. The final transmuted score was used in the case of these four subjects. However, in Social Studies and Science the students are given a mark for the year's work by the teacher which is counted for fifty percent of the total mark the student receives. About ten percent of the cases were examined and it was found that the relative effect of the marks given by teachers varied considerably from one group to another. Teachers of multi-grade schools tended to give students marks which were considerably above the marks received on the examinations. In the case of single grade schools the teachers' marks on the average were the same as, or slightly below the marks students received on the examinations. In view of this it was decided that teachers' marks would not be used and so the transmuted scores which the students obtained from the examination are used in these two subjects. The assumption of normality is justified

because the transmuted scores have been normalized.

## Equating of Mean Ability

The first problem in analysis was to control for differences in ability among the four groups. This was done by equating the mean ability score of the four groups. The mean score on the ability test for each group was found. The original mean ability level for each group were found to be as follows: the single-grade group, 67.92; the double-grade group 68.06; the lower multi-grade group, 66.14; and the higher multi-grade group, 63.16. Since the higher multi-grade group had considerably fewer students in it, the mean ability level of the other groups were made equal to the mean ability level of the higher multi-grade group. This was done by randomly casting out cases until the mean ability levels of the other groups were equal to 63.16, the mean ability level of the higher multi-grade group.

## Comparing Achievement

To determine whether or not differences in achievement are significant the method of analysis of variance is used. This involves an F-test which indicates whether differences are significant, followed by a t-test, if significance is shown, applied to the groups two at a time in order to determine which specific groups are significantly different.[2] If the F-test does not show significance, further tests are not required. In all cases, the null hypothesis is that no significant difference in

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[2] G. A. Ferguson, Statistical Analysis in Psychology and Education (New York: McGraw-Hill Book Co., Inc., 1959), pp. 227-241.

mean achievement exists. In this study, the accepted levels of significance are .01, .05 and .10.

# CHAPTER II

# RELATED LITERATURE AND RESEARCH

## I. AN OVERVIEW OF RESEARCH ON VARIABLES AFFECTING ACHIEVEMENT

A great deal of research has been carried out and much as been written about the relative efficiency of large and small schools. However, the findings and opinions are not consistent regarding academic achievement in various sized schools.

In 1947-48 J. Schunert carried out a study in one hundred schools in Minnesota to determine the status of mathematics instruction and to investigate the relation of mathematical achievement to certain factors resident in the teacher, the teaching, the pupil and in the school. Some of his findings were as follows: boys exceeded girls in geometry; algebra classes with enrolments of twenty to thirty exceeded achievement of larger and smaller classes; and schools whose enrolment was between one hundred and five hundred achieved the best results in mathematics.[1]

Anderson attempted to determine the relationship between teacher load and student achievement.[2] He worked in the field of chemistry and considered the teaching load as the number of students in each class

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[1] J. Schunert, "The Association of Mathematical Achievement With Certain Factors Resident in the Teacher, in the Teaching, in the Pupil, and in the School," Journal of Experimental Education, XIX (March, 1951), 219-238.

[2] K. E. Anderson, "The Relationship Between Teacher Load and Student Achievement," School Science and Mathematics (1950), 468-470.

times the number of classes each day. He carried on his work in two parts, one part consisting of fifty-six schools in Minnesota and the second part made up of seventeen schools in eight different states. In both cases, when holding intelligence and pre-experiment knowledge constant it was found that students achieved significantly more in chemistry when the number of pupils handled per day per teacher placed the teacher in the lower one-fourth of the distribution rather than in the upper fourth.

Spitzer considered class size and pupil achievement in the third and sixth grades in Iowa in 1953. Using the Iowa Every Pupil Test of Basic Skills he examined four areas: reading comprehension, study skills, language skills and arithmetic skills. No significant difference was found in the achievement of various sized classes.[3]

In a similar study Horn found that class size was not an important factor in determining achievement as commonly measured, as far as Social Studies are concerned.[4]

Shimburg compared the academic performance of rural and urban children and found urban children achieved significantly better.[5]

However, Broady, in reviewing research, came to the conclusion that when the achievement of pupils is used as a criterion, the evidence

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[3] H. F. Spitzer, "Class Size and Pupil Achievement," Elementary School Journal, LV (October, 1954), 82-86.

[4] E. Horn, Methods of Instruction in Social Studies (New York: Scribner's Sons, 1937), 68-72.

[5] M. E. Shimburg, "An Investigation Into the Validity of Norms With Special Reference to Urban and Rural Groups," Archives of Psychology, XVI: 1629-39.

is not clear as to whether small schools are inferior.[6] And Cooper, Dawson, Isenburg, after surveying the research, found that although large schools were found superior when considered from the point of view of desirable characteristics, there was no evidence to support the theory that the students of larger schools achieved at a higher level.[7]

## II. RELATED ALBERTA STUDIES

Bodnaruk tested the achievements of students living on farms and taking Grade Nine and Twelve in three rural centralized schools and one town school in the County of Ponoka, Alberta. The students of the rural schools completed Grade Eleven in the rural schools and Grade Twelve in the town school. The three small high schools had a teacher-grade ratio of less than one.

Bodnaruk surveyed students and teachers in both situations and found that the majority of students and teachers expected that results would be better in the town schools.

However, this study found that the difference in academic achievement of the two groups of Grade Nine and Twelve students was not statistically significant even though the town school had several advantages: better facilities, class periods were longer, teachers were better qualified, teachers had fewer courses to teach, teachers had more

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[6] K. O. Broady, "Small School Systems," Encyclopedia of Educational Research, III (1960), 1166-70.

[7] Cooper, Dawson, Isenburg, "Rural Education," Encyclopedia of Educational Research, III (1960), 1166-70.

experience and teachers were more often teaching in specific fields for which they were trained.[8]

It appears that there are three basic reasons why Bodnaruk's study would not have found differences if they did exist. In that study the abilities of the two groups were not equated and in fact the ability levels of the two groups were assumed to be the same. In addition to this, while both groups were from farms, it is possible that the environments and backgrounds of the two groups may have been dissimilar. The question of dissimilarity of ability levels, background and environment, assumes greater significance if it is noted that the numbers of students in many cases were very small. The likelihood of differences would seem too great to assume otherwise, particularly when the numbers involved are small.

That no significant differences were found may also be due to the fact that stanines were used as units of measurement rather than raw scores or percentage gradings. No only are stanines very large units but in many cases, due to the small numbers involved, as many as four stanine standings were grouped together. It does not seem surprising, therefore, that differences were not significant. The present study uses percentage gradings and in addition equalizes the mean ability levels of the groups. It is the writer's opinion that these two factors greatly increase the likelihood of accuracy.

J. W. Chalmers discussed small schools in an article in The

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[8] Wm. A. Bodnaruk, "A Comparative Study of Examination Results in Grades Nine and Twelve in One Town School and in Three Rural Centralized Schools in the County of Ponoka," (unpublished Master's thesis, University of Alberta, 1962).

Alberta School Trustee.[9] He stated:

> We continue to operate and open two-room elementary institutions, one or two-room high schools, or small combinations of both. Yet such schools are commonly inadequate in accommodation, defective in equipment, narrow in program offered, poorly staffed, and generally unsatisfactory in every respect except proximity to the pupil's homes.[10]

Chalmers also said that a study of provincial examination results in Grade Nine for the term 1957-58 and a study of Grade Twelve examination results for the period 1953-56 for schools of various sizes suggested that as far as secondary education at least was concerned, the small schools were inefficient.

Chalmers included the following tables:

TABLE I

GRADE NINE RESULTS 1957-1958[a]

| Size of Grade Nine Class | Percent of Failure |
|---|---|
| 1 - 15 students | 19.69 |
| 16 - 30 students | 15.83 |
| 31 - or more students | 11.25 |
| City Schools | 8.34 |

[a] J. W. Chalmers, "School Grants in Alberta," The Alberta School Trustee (December, 1959), 21.

Table I compares the percentage of failures in various sized classes of non-city students to each other and to city classes. Larger classes obtained a smaller percentage of failures than smaller classes.

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[9] J. W. Chalmers, "School Grants in Alberta," The Alberta School Trustee (December, 1959), 21.

[10] *Ibid.*, p. 21.

City schools had a smaller percentage of failures than non-city schools.

TABLE II

GRADE TWELVE RESULTS JUNE 1958[a]

| Size of School | B or Better | C Only | D Only |
|---|---|---|---|
| Less than 1 teacher/grade | 44.9 | 27.8 | 27.3 |
| Fewer than 15 Grade Twelve students | 54.8 | 25.7 | 19.6 |
| 15 - 39 students | 62.5 | 23.2 | 14.3 |
| 40- 99 students | 61.9 | 25.0 | 13.2 |
| 100 or more students | 69.8 | 20.3 | 9.9 |

[a] J. W. Chalmers, "School Grants in Alberta," *The Alberta School Trustee* (December, 1959), 21.

Table II compares the achievement of grade twelve results in various schools categorized mainly according to size. This table indicates that larger schools tend to produce better grade twelve results. However, it should be kept in mind that there was no controlling of variables in this study.

TABLE III

GRADE TWELVE RESULTS IN ONE INSPECTORATE 1953-56[a]

| Size of School | B or Better | C or Better | D Only |
|---|---|---|---|
| One teacher Grades X-XII | 35.8 | 64.3 | 35.7 |
| Two teachers Grades IX-XII | 32.6 | 65.9 | 34.1 |
| Three teachers Grades IX-XII | 43.1 | 73.8 | 26.2 |
| One teacher/grade | 57.0 | 83.2 | 16.2 |
| More than one teacher/grade | 66.8 | 89.1 | 10.9 |

[a] J. W. Chalmers, "School Grants in Alberta," *The Alberta School Trustee* (December, 1959), p. 21.

Table III compares grade twelve results of students taught in various situations categorized according to the ratio of teachers to numbers of grades. This shows that schools with higher ratios of teachers to grades obtain higher results.

He states an example of poor school organization which is significant in this study:

> For example, there is in central Alberta a school districh which last year started the school term with only one hundred thirty-eight pupils, of whom nineteen were in the high school grades. This school lies between two other high schools about ten or twelve miles on either side, which its pupils could attend. The district could be adequately served by an elementary-junior high school of five classrooms. Yet it has built a school consisting of six classrooms plus other facilities, a science room, a typing room, home economics centre for industrial arts shop--totalling an additional 6.2 classroom units for grant purposes.[11]

It seems reasonable to assume that the argument could be used for junior high schools in many cases. However, it must be recognized that there was very little effort to control variables in the above study. The above article probably cannot rightly be called research in any strict sense of the word. The writer feels this statement justified because of lack of control of other variables affecting achievement, particularly ability. Other variables which have not been mentioned are school equipment and supplies and teacher characteristics. Furthermore, no explanation of the population is given and justification for the year or years used is missing. In addition, statistical tests are not used, nor is level of significance mentioned.

The present study eliminates the effects of teachers' ratings in

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[11] Ibid., p. 21.

Grade Nine Social Studies and Science. Black's study of final marks that teachers give to students in Grade Ten and Eleven, as compared to the marks that the students receive in Grade Twelve departmental examinations, revealed an almost uniformly higher rating of students by teachers in the small schools.[12] He stated:

> It hardly seems fair to students to be lulled into a sense of complacency in Grades Ten and Eleven only to face a "rude awakening" upon receipt of their Grade Twelve departmental marks.[13]

It seems reasonable to assume that the same might be said about the ratings by teachers in smaller schools of Grade Seven and Eight students. This tendency of teachers in smaller schools to over-rate students may be carried over to the grade nine level and thus teachers' gradings in Grade Nine Social Studies and Science were not used even though it might be argued that these marks are indicative of achievement not measured by the final examinations.

Three other Alberta research projects which are indirectly related to the present study were conducted by Lindstedt,[14] Eddy,[15] and Wasyluk.[16]

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[12] D. B. Black, "Final Marks in Alberta Senior High Schools," The Alberta Journal of Educational Research, VI (September, 1960), 150.

[13] *Ibid.*, p. 150.

[14] S. A. Lindstedt, "Teacher Qualifications and Grade Nine Mathematics Achievement" (unpublished Master's thesis, University of Alberta, 1960).

[15] W. P. Eddy, "Teacher Characteristics and Grade Nine Social Studies Achievement" (unpublished Master's thesis, University of Alberta, 1962).

[16] E. Wasyluk, "Teacher Characteristics and Grade Twelve Mathematics Achievement" (unpublished Master's thesis, University of Alberta, 1961).

Lindstedt examined the relationship between grade nine mathematics and four teacher characteristics: years of teaching experience, years of professional training, number of university mathematics courses taken, and subject preference of the teachers. He also investigated the differences between city and non-city teachers on the four above-mentioned characteristics and the differences in mathematics results between city and non-city students. City teachers were found to exceed non-city teachers in years of training, in the number of university mathematics courses taken, and in being more often placed according to their subject preference. Years of experience were not found to be significantly different between city and non-city teachers.

Lindstedt found that students of teachers with more experience tend to achieve better results in Grade IX mathematics. Teachers with four or more years of experience also tended to produce higher examination results. Lindstedt's study also found that students of teachers teaching in their area of preference obtained higher standings on final grade nine mathematical examinations. The number of university mathematics courses taken by teachers was found not to have measurable effect on students' marks.

However, the differences found above were not reflected in differences in achievement between city and non-city students, according to this study. No significant difference was found between the two above groups in mathematics achievement.

Lindstedt's study uses large numbers of students. Because of this, large differences in mean achievement would not be expected. However, in addition Lindstedt used the stanine scores as units of measurement, It is possible that differences in achievement were present

between city and non-city students but were not found to be significant because of the use of these units. It is also possible that real differences did not exist. It may be that the text books in mathematics more nearly constitute "the course" than in other subjects. In addition, the final examination may be more closely based on the text than in other courses. If these two thoughts are true, this would tend to decrease the effect of the teacher. Also, it should be noted that the factor of mental abilities was not controlled in Lindstedt's study.

Eddy[17] examined the relationship between certain teacher characteristics and grade nine social studies achievement. He found significant positive relationships between grade nine social studies achievement and the following: number of years of training, number of university social studies courses taken, number of years' experience, and subject-field preference. However, characteristics of age, median-sized class, hours per week devoted to the teaching job and sex were not found to be effective on social studies achievement.

City teachers were found to exceed non-city teachers on all the above-mentioned characteristics except number of university courses taken, number of years' teaching experience, age, and number of hours per week devoted to teaching. No significant difference was found between the sexes.

City students also were found to have achieved significantly better results than non-city students.

Wasyluk[18] investigated the relationship between grade twelve

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[17] Eddy, _op. cit._ [18] Wasyluk, _op. cit._

mathematics achievement and the following teacher characteristics: number of years of professional training beyond Grade Twelve, the number of university mathematics courses taken, the number of years of teaching experience and the subject-field preference for teaching. A comparison of city and non-city teachers on the above characteristics was made as well as a comparison of city and non-city student achievement in Grade Twelve mathematics.

A positive relationship was found to exist between student achievement in grade twelve mathematics and all four of the characteristics studied. City teachers were found to surpass non-city teachers in all of the characteristics except in their subject-field preference for teaching. Finally, city students were found to have achieved significantly better results than non-city students.

Of the four Alberta studies, all seemed to agree that larger schools tended to have better qualified teachers as well as other advantages. However, only two studies found these advantages to be reflected in better student achievement. The other two did not find any significant differences in achievement. The studies which found differences did, however, control on more variables, and also, Bodnaruk's[19] study had several weaknesses which were discussed.

The foregoing Alberta studies relate to the present study only in so far as they compare the achievement of rural and urban students and thus indirectly compare large schools with small schools, and various types of school organization. These studies also relate to this

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[19] Bodnaruk, *op. cit.*

research in that they examine the effect of various factors on school achievement. It should be noted, however, that none of the research discussed in this section examines exactly the same questions as this study attempts to do.

## III. STUDIES OF THE EFFECT OF CONSOLIDATION ON ACADEMIC ACHIEVEMENT

Andrews investigated the effect of secondary consolidation upon achievement and cost in an area of British Columbia.[20] He attempted to determine if the achievement of the secondary school pupils who are transported to the consolidated schools is superior to, inferior to, or the same as the equivalent pupils who attend small rural high schools. Andrews found that although the mean achievement of the transported consolidated group was 51.10 compared to 47.75 for the rural group, there was no significant difference in achievement at the .01 level.

In a survey of the literature pertinent to his study, Andrews summarizes that:

> . . .Studies relating the two factors 'size of school' and 'general quality of education' are reported to favor the large school overwhelmingly. When 'size of school' and 'actual achievement' are related, however, the result is found to be varied with approximately half the studies favoring the large school and the other half finding no significant difference. It is noted that most of the latter studies are more closely controlled than the former.[21]

In a study conducted in Australia, Kemp concluded among other things that large enrolment was a main factor in determining level of

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[20] J. H. M. Andrews, "The Effect of Secondary Consolidation Upon Achievement in Fundamentals and Unit Cost" (unpublished Master's thesis, University of British Columbia, 1954), p. 35.

[21] Ibid.

attainment whereas class size did not seem important.[22] It is interesting to note that he found that school morale was an important factor. This may be a partial explanation of the relatively high achievement of small schools in some cases.

Somewhat related to this was a study by Spivak of a junior high school in an underprivileged area in Newark, New Jersey. He found children who had been in a departmentalized set-up in the Seventh and Eighth grades did not do better, academically or with regard to school adjustment, when they reached the Ninth grade than did their matches who had been in self-contained classrooms in the Seventh and Eighth grades. There was evidence that the children from self-contained classrooms did better by statistically significant amounts in some areas: they did better academically; they made more friends by the end of the year; they reported fewer school problems and were referred less frequently for advice and correction.[23]

Eisemann was responsible for a longitudinal study of two areas in Wisconsin, one of which was organized as one school unit, the other being made up of small distinct districts. The unorganized units would likely contain more multi-grade situations, and smaller schools. This study was begun in 1949 and will continue until 1972. However, he published an interim report which suggests that evidence to that date shows that the reorganized district has resulted in increased achievement when factors

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[22] L. D. Kemp, "Environmental and Other Characteristics Determining Attainment in Primary Schools," British Journal of Educational Psychology, XXV (1956), 67-76.

[23] M. L. Spivak, "Effectiveness of Departmental and Self-Contained Seventh and Eighth Grade Classroom," School Review, LXIV (1956), 391-396.

such as intelligence, socio-economic status and teacher characteristics have been controlled.[24]

Drefer carried out research to determine what difference, if any, existed between the achievement of rural children from graded and ungraded schools when measured by tests in reading, language, arithmetic, and spelling at the Sixth, Ninth and Twelfth grade levels. This research was carried out in Wisconsin.[25]

Drefer reviewed previous research in this area before doing his study and came to the conclusion that it had not been shown by several previous studies that the ungraded school did not produce as high a level of achievement either at the elementary or secondary level.[26]

He found that Sixth grade pupils of the two groups did not differ significantly at the one percent level in any of the areas. At the Ninth grade level he found that students of ungraded school backgrounds were lower in language and reading achievement, significant at the five percent level and one percent level, respectively. The Twelfth grade students of graded school backgrounds scored higher on reading, language, spelling, and arithmetic test scores, significant at the five percent level.[27]

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[24] C. Eisemann, "In Reorganized Districts Children Do Learn More," Nation's Schools, LXIX (June, 1957), 61-63.

[25] W. H. Drefer, "Differential Achievement of Rural Graded and Ungraded School Pupils," Journal of Educational Research, XLIII (1949), 175-186.

[26] Ibid. [27] Ibid., p. 177.

## IV. SUMMARY

The related literature and related studies present conflicting answers as to the effect upon achievement of class size, grade per teacher ratio and enrolment. However, those studies which have found differences have found them in favor of smaller class sizes, single grade situations and large school enrolments.

It seems possible that in many cases differences were not found due to large units of measurement and other weaknesses in the studies. In the writer's opinion the evidence indicates that schools with the above-mentioned characteristics do result in higher academic achievement.

The present study may aid in determining the relationship of achievement to single grade and multi-grade situations at the Grade Nine Level in Alberta.

# CHAPTER III

# ANALYSIS OF DATA

## I. INTRODUCTION

The chapter contains tables and text which summarize and explain the analysis of the data.

## II. EQUATING OF MEAN ABILITY

Before the actual analysis of data could be started, it was necessary to control for differences in ability among the four groups. The mean standings of the four groups on the Grade Nine Ability Test were found. The mean ability levels of the four groups were as follows: the single-grade (SG) group mean was 67.92; the double-grade (DG) mean was 68.06; the lower multi-grade (LMG) group mean was 66.24; and the higher multi-grade mean was 63.16. Table IV contains a summary of the finding of the original means.

TABLE IV

ORIGINAL STATUS OF THE FOUR GROUPS ON ABILITY TEST

| Group | Number of Schools | Original Number of Students | Original Sum of Scores | Original Mean |
|---|---|---|---|---|
| SG Single Grade | 202 | 3,835 | 260,458 | 67.92 |
| DG Double Grade | 28 | 1,151 | 76,335 | 68.06 |
| LMG Lower Multi-Grade | 111 | 727 | 48,159 | 66.24 |
| HMG Higher Multi-grade | 28 | 242 | 15,285 | 63.16 |

Since the higher multi-grade (HMG) group has considerably fewer students than the other groups, it was decided to make the mean of the other groups equal to the higher multi-grade group. This was done by randomly casting out cases above or below the mean as required, until the mean of the group was equal to that of the higher multi-grade group.

Table V summarizes the results of equalizing the mean abilities of the various groups. The new mean of all of the groups became 63.16 to equal that of the higher multi-grade group.

As mentioned in the last chapter of this thesis, the equalization of ability levels probably resulted in fewer significant differences being found. It is the writer's opinion that the Grade Nine Ability Test, to a considerable extent, measures achievement as well as ability. Thus, when we equalize ability on the basis of this test we are in effect cancelling out part of the effect of the schools.

TABLE V

MEAN ABILITY OF GROUPS AFTER CASTING OUT CASES

| Group | Number of Schools | Original Number | Cases Cast Out | Number Remaining | New Sum Ability Scores | New Mean |
|---|---|---|---|---|---|---|
| SG Single Grade | 202 | 3,835 | 1,036 | 2,799 | 176,775 | 63.16 |
| DG Double Grade | 28 | 1,151 | 301 | 850 | 53,685 | 63.16 |
| LMG Lower Multi-Grade | 111 | 727 | 130 | 597 | 37,706 | 63.16 |
| HMG Higher Multi-Grade | 28 | 242 | Nil | 242 | 15,285 | 63.16 |

## III. ANALYSIS OF DATA

### Discussion of Analysis of Variance

The main method of analysis used is the analysis of variance and the pattern used is that outlined by Ferguson.[1] When significant difference is found using this test, it is followed by the t-test, applied to the groups in pairs. The one-tailed t-test is used since it is known which mean is higher and a test for difference in only one direction is required.

In the analysis of variance tables, the following abbreviations are used:

$n_j$ which means the number of pupils in the group,

$T_j$ which is the sum of the students marks in that subject or subjects,

$X_j$ which is the average mark in that group,

$\underline{n_j}$ X $ij^2$ is the sum of squares of marks in that group

$\overline{i=1}$

$\frac{T_j^2}{n_j}$ is the total sum of marks, divided by the number of members in the group.

### Composite Achievement

The first analysis is of composite achievement, that is, the total achievement on the six examination subjects.

Table VI summarizes the analysis of variance of composite

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[1] G. A. Ferguson, Statistical Analysis in Psychology and Education (New York: McGraw-Hill Book Co., Inc., 1959), 227-241.

achievement of the four groups. The difference in mean composite achievement is found to be only slightly significant, the level of significance being between .10 and .05. However, the t-test was applied in pairs and significant differences in achievement were found.

TABLE VI (a)

ANALYSIS OF VARIANCE APPLIED TO COMPOSITE ACHIEVEMENT OF GRADE NINE STUDENTS IN FOUR CLASSIFICATIONS OF SCHOOLS

| | Group SG | Group DG | Group LMG | Group HMG |
|---|---|---|---|---|
| $N_j$ | 2,799 | 850 | 597 | 242 |
| $T_j$ | 874,471 | 269,527 | 182,496 | 75,704 |
| $X_j$ | 312.42 | 317,09 | 305.69 | 312.83 |
| $\sum_{i=1}^{nj} X_{ij}^2$ | 289,984,870 | 90,884,325 | 59,911,706 | 25,054,131 |
| $\frac{Tj^2}{nj}$ | 273,204,547.9 | 85,464,474.9 | 55,786,917.9 | 23,682,213.3 |

TABLE VI (b)

SUMMARY OF ANALYSIS OF VARIANCE--COMPOSITE ACHIEVEMENT

| Source of Variation | | Sum of Squares | Degrees of Freedom | Variance Estimates |
|---|---|---|---|---|
| Between | = | 45,633.7 | K-1 = 3 | 15,211.2 |
| Within | = | 27,196,878 | N-K = 4,484 | 6,653.2 |
| Total | = | 27,242,511.7 | N-1 = 4,487 | F = 2.29 |

F df $(3,\infty)$ required for significance at .10, .05 and .01 levels of significance are 2.08, 2.60 and 3.78 respectively

Table VII shows the results of the t-test applied to the groups

taken two at a time. The composite achievement of the double-grade group was found to be significantly higher than the composite achievement of the single-grade nine group at the .01 level. The single-grade group and the double-grade group also achieved higher results than did the lower multi-grade group, significant at the .05 and .01 levels respectively. No significant difference in composite achievement was found between the following pairs of groups: single-grade and higher multi-grade, double-grade and higher multi-grade, and lower multi-grade and higher multi-grade.

TABLE VII

T-TEST APPLIED TO COMPOSITE ACHIEVEMENT

| Groups | t | Higher Group Mean | Significance |
|---|---|---|---|
| SG and DG | 1.5 | DG | Significant at .10 level |
| SG and LMG | 1.8 | SG | Significant at .05 level |
| SG and HMG | .07 | HMG | Not significant |
| DG and LMG | 2.6 | DG | Significant at .01 level |
| DG and HMG | .72 | DG | Not significant |
| LMG and HMG | 1.2 | HMG | Not significant |

When df $= \infty$, the t's required for significance at the .10, .05 and .01 levels are 1.28, 1.65 and 2.33, respectively.

## Reading

Table VIII summarizes the results of analysis of variance applied to Reading achievement of the four groups. This test did not show any

significant difference in Reading achievement of the students in the four classifications of schools.

## TABLE VIII (a)

## ANALYSIS OF VARIANCE APPLIED TO READING ACHIEVEMENT OF GRADE NINE STUDENTS IN FOUR CLASSIFICATIONS OF SCHOOLS

| | Group SG | Group DG | Group LMG | Group HMG |
|---|---|---|---|---|
| $n_j$ | 2,799 | 850 | 597 | 242 |
| $T_j$ | 142,371 | 42,823 | 30,423 | 12,264 |
| $X_j$ | 50.86 | 50.38 | 50.96 | 50.68 |
| $\sum_{i=1}^{n_j} X_{ij}^2$ | 7,895,271 | 2,374,423 | 1,698,989 | 674,456 |
| $\frac{T_j^2}{n_j}$ | 7,241,694.4 | 2,157,422.7 | 1,550,349.9 | 621,511.1 |

## TABLE VIII (b)

## SUMMARY OF ANALYSIS OF VARIANCE - READING

| Source of Variation | Sum of Squares | Degrees of Freedom | Variance Estimate |
|---|---|---|---|
| Between | = 178.3 | K-1 = 3 | 59.4 |
| Within | = 1,072,160.9 | N-K = 4484 | 239.1 |
| Total | = 1,072,339.2 | N-1 = 4487 | F = .25 |

Fdf $(3, \infty)$ required for significance at .10, .05 and .01 levels of significance are 2.08, 2.60 and 3.78, respectively.

The analysis of variance applied to the Reading results does not

show any significant differences in achievement and is therefore not followed by the t-test.

## Literature

The results of analysis of variance applied to the Literature achievement of the four groups is shown in Table IX. This statistical test produced an F equal to 4.7 which is significant at the .01 level. The t-test was then applied to determine which groups differed in Literature achievement.

TABLE IX (a)

ANALYSIS OF VARIANCE APPLIED TO LITERATURE ACHIEVEMENT OF GRADE NINE STUDENTS IN FOUR CLASSIFICATIONS OF SCHOOLS

| | Group SG | Group DG | Group LMG | Group HMG |
|---|---|---|---|---|
| nj | 2,799 | 850 | 597 | 242 |
| Tj | 142,600 | 44,485 | 29,410 | 12,256 |
| $\bar{X}j$ | 50.95 | 52.34 | 49.26 | 50.65 |
| $\sum_{i=1}^{nj} Xij^2$ | 7,912,360 | 2,542,133 | 1,580,090 | 699,656 |
| $\frac{Tj^2}{nj}$ | 7,264,907.4 | 2,328,135.6 | 1,448,824.3 | 620,700 |

## TABLE IX (b)

## SUMMARY OF ANALYSIS OF VARIANCE - LITERATURE

| Source of Variation | Sum of Squares | Degrees of Freedom | Variance Estimates |
|---|---|---|---|
| Between | 3,249.7 | K-1 = 3 | 1,083.2 |
| Within | 1,041,671.1 | N-K = 4484 | 232.1 |
| Total | 1,044,920.8 | N-1 = 4487 | F = 4.7 |

Fdf $(3, \infty)$ required for significance at .10, .05 and .01 levels of significance are 2.08, 2.60 and 3.78, respectively.

Results of the t-test applied to the Literature achievement of the groups is outlined in Table X. The double-grade nine group was found to have achieved significantly higher than the other three groups. The levels of significance for the differences between the double-grade group and the single-grade group, the lower multi-grade group, and the higher multi-grade group were .01, .01 and .10, respectively. The t of 3.80 found when comparing the double-grade group and the lower multi-grade group is highly significant and should be noted. No significant differences in Literature achievement were found between the single-grade and higher multi-grade groups. The differences between the lower multi-grade and higher multi-grade groups also were not significant. The single-grade group achievement in Literature was significantly higher than that of the lower multi-grade group, at the .01 level.

### TABLE X

### T-TEST APPLIED TO LITERATURE ACHIEVEMENT

| Groups | t | Higher Group Mean | Significance |
|---|---|---|---|
| SG and DG | 2.33 | DG | Significant at .01 level |
| SG and LMG | 2.45 | SG | Significant at .01 level |
| SG and HMG | .29 | SG | Not significant |
| DG and LMG | 3.80 | DG | Significant at .01 level |
| DG and HMG | 1.52 | DG | Significant at .10 level |
| LMG and HMG | 1.20 | HMG | Not significant |

The t's required for significance at the .10, .05 and .01 levels when df = $\infty$, are 1.28, 1.65 and 2.33, respectively.

Language

Table XI summarizes the results of analysis of variance applied to the Language achievement of the students in the four groups. An F of 7.47 resulted which is significant at the .01 level and justifies the t-test being used to determine which groups differ. The F of 7.47 is exceptionally high and indicates a significance at a very high level.

### TABLE XI (a)

### ANALYSIS OF VARIANCE APPLIED TO LANGUAGE ACHIEVEMENT OF GRADE NINE STUDENTS IN FOUR CLASSIFICATIONS OF SCHOOLS

| | Group SG | Group DG | Group LMG | Group HMG |
|---|---|---|---|---|
| nj | 2,799 | 850 | 597 | 242 |
| Tj | 148,089 | 46,082 | 30,133 | 12,711 |
| $\bar{X}j$ | 52.91 | 54.21 | 50.47 | 52.52 |
| $\sum_{i=1}^{nj} Xij^2$ | 8,448,389 | 2,706,720 | 1,641,061 | 721,525 |
| $\frac{Tj^2}{nj}$ | 7,835,066.7 | 2,498,295.0 | 1,520,934.1 | 667,642.6 |

### TABLE XI (b)

### SUMMARY OF ANALYSIS OF VARIANCE - LANGUAGE

| Source of Variation | Sum of Squares | Degrees of Freedom | Variance Estimate |
|---|---|---|---|
| Between | 4,979.8 | K-1 = 3 | 1,659.9 |
| Within | 995,756.6 | N-K = 4,484 | 222.1 |
| Total | 1,000,736.4 | N-1 = 4,487 | F = 7.47 |

The Fdf $(3, \infty)$ required at the .10, .05 and .01 levels of significance are 2.08, 2.60 and 3.78, respectively.

The t-test, summarized in Table XII, shows that the double-grade students obtained significantly higher results than the students of the other three groups. The levels of significance where the double-grade group was compared to the others was as follows: single-grade, .05; lower

multi-grade, .01; and higher multi-grade .10. Single-grade achievement was significantly (.05 level) higher than lower multi-grade achievement as was higher multi-grade achievement (.05 level). No significant difference in Language achievement resulted from the t-test applied to the single-grade and higher multi-grade groups.

TABLE XII

T-TEST APPLIED TO LANGUAGE ACHIEVEMENT

| Groups | t | Higher Group Mean | Significance |
|---|---|---|---|
| SG and DG | 2.24 | DG | Significant at .05 level |
| SG and LMG | 3.64 | SG | Significant at .05 level |
| SG and HMG | .39 | SG | Not significant |
| DG and LMG | 4.68 | DG | Significant at .01 level |
| DG and HMG | 1.56 | DG | Significant at .10 level |
| LMG and HMG | 1.8 | HMG | Significant at .05 level |

The t's required for significance at the .10, .05 and .01 levels are 1.28, 1.65 and 2.33, respectively.

### Social Studies

The analysis of variance test did not result in an F large enough to indicate significant differences in mean achievement among the groups in Social Studies. This test is outlined in Table XIII. In view of this, the t-test was not applied to Social Studies achievement.

## TABLE XIII (a)

## ANALYSIS OF VARIANCE APPLIED TO SOCIAL STUDIES ACHIEVEMENT OF GRADE NINE STUDENTS IN FOUR CLASSIFICATIONS OF SCHOOLS

| | Group SG | Group DG | Group LMG | Group HMG |
|---|---|---|---|---|
| nj | 2,799 | 850 | 597 | 242 |
| Tj | 144,440 | 43,801 | 30,308 | 12,705 |
| $\bar{X}j$ | 51.60 | 51.53 | 50.77 | 52.50 |
| $\sum_{i=1}^{nj} Xij^2$ | 8,061,160 | 2,455,947 | 1,670,512 | 721,213 |
| $\frac{Tj^2}{nj}$ | 7,453,700.3 | 2,257,091.3 | 1,538,651.3 | 667,012.5 |

## TABLE XIII (b)

## SUMMARY OF ANALYSIS OF VARIANCE - SOCIAL STUDIES

| Source of Variation | Sum of Squares | Degrees of Freedom | Variance Estimate |
|---|---|---|---|
| Between | 588.1 | K-1 = 3 | 196.0 |
| Within | 992,376.6 | N-K = 4,484 | 221.3 |
| Total | 992,964.7 | N-1 = 4,487 | F = .9 |

The Fdf $(3,\infty)$ required for significance at the .10, .05 and .01 levels are 2.08, 2.60 and 3.78, respectively.

Mathematics

A synopsis of analysis of variance applied to mathematics achievement is contained in Table XIV. The F produced (1.6) indicates that no

significant difference in mathematics achievement exists among the four groups. Therefore, analysis of variance was not followed by the t-test.

### TABLE XIV (a)

### ANALYSIS OF VARIANCE APPLIED TO MATHEMATICS ACHIEVEMENT OF GRADE NINE STUDENTS IN FOUR CLASSIFICATIONS OF SCHOOLS

| | Group SG | Group DG | Group LMG | Group HMG |
|---|---|---|---|---|
| nj | 2,799 | 850 | 597 | 242 |
| Tj | 150,912 | 46,921 | 32,204 | 13,208 |
| $\bar{X}j$ | 53.92 | 55.20 | 53.94 | 54.58 |
| $\sum_{i=1}^{nj} Xij^2$ | 8,815,434 | 2,796,455 | 1,890,262 | 776,906 |
| $\frac{Tj^2}{nj}$ | 8,136,631.6 | 2,590,094.4 | 1,737,181.9 | 720,872.9 |

### TABLE XIV (b)

### SUMMARY OF ANALYSIS OF VARIANCE - MATHEMATICS

| Source of Variation | Sum of Squares | Degrees of Freedom | Variance Estimate |
|---|---|---|---|
| Between | 1,151.1 | K-1 = 3 | 383.7 |
| Within | 1,094,276.2 | N-K = 4,484 | 244.0 |
| Total | 1,095,427.3 | N-1 = 4,487 | F = 1.6 |

The Fdf $(3,\infty)$ required for significance at the .10, .05, and .01 levels are 2.08, 2.60 and 3.78, respectively.

## Science

The analysis of variance applied to the Science results, summarized in Table XV, produced an F equal to 5.4 which indicates significant differences in mean achievement.

### TABLE XV (a)

### ANALYSIS OF VARIANCE APPLIED TO SCIENCE ACHIEVEMENT OF GRADE NINE STUDENTS IN FOUR CLASSIFICATIONS OF SCHOOLS

| | Group SG | Group DG | Group LMG | Group HMG |
|---|---|---|---|---|
| nj | 2,799 | 850 | 597 | 242 |
| Tj | 146,059 | 45,415 | 30,018 | 12,560 |
| $\bar{X}j$ | 52.18 | 53.43 | 50.28 | 51.90 |
| $\sum_{i=1}^{nj} Xij^2$ | 8,233,301 | 2,620,923 | 1,636,364 | 703,942 |
| $\frac{Tj}{nj}$ | 7,621,733.3 | 2,426,496.7 | 1,509,347.3 | 651,874.4 |

### TABLE XV (b)

### SUMMARY OF ANALYSIS OF VARIANCE - SCIENCE

| Source of Variation | Sum of Squares | Degrees of Freedom | Variance Estimate |
|---|---|---|---|
| Between | 3,493.9 | K-1 = 3 | 1,164.6 |
| Within | 975,078.3 | N-K = 4,484 | 217.5 |
| Total | 978,572.2 | N-1 = 4,487 | F = 5.4 |

The Fdf $(3, \infty)$ required for significance at the .10, .05 and .01

levels are 2.08, 2.60 and 3.78, respectively.

Because the analysis of variance test indicated significant differences in mean achievement in Science, the t-test was applied to the groups taken two at a time to discover which groups differed. A summary of the t-test results are contained in Table XVI. The single-grade and higher multi-grade mean achievements in Science were not found to differ significantly. However, double-grade mean achievement in Science was found to be significantly higher than that of the single-grade group (.05 level), the higher multi-grade group (.10 level) and the lower multi-grade group (.01 level). Single-grade achievement also proved significantly higher than lower multi-grade achievement in Science (.01 level). The higher multi-grade group was also significantly higher than the lower multi-grade group, at the .10 level.

TABLE XVI

T-TEST APPLIED TO SCIENCE ACHIEVEMENT

| Groups | t | Higher Group Mean | Significance |
|---|---|---|---|
| SG and DG | 2.15 | DG | Significant at .05 level |
| SG and LMG | 2.88 | SG | Significant at .01 level |
| SG and HMG | .29 | SG | Not significant |
| DG and LMG | 3.99 | DG | Significant at .01 level |
| DG and HMG | 1.43 | DG | Significant at .10 level |
| LMG and HMG | 1.45 | HMG | Significant at .10 level |

The t's required for significance at the .10, .05 and .01 levels are 1.28, 1.65, and 2.33, respectively.

## IV. SUMMARY OF ANALYSIS OF VARIANCE

Table XVII summarizes the results of analysis of variance tests in each of the seven selected areas of achievement. Significant differences in mean achievement were found in four classes: Composite achievement (.10 level); Literature (.01 level); Language achievement (.01 level); and Science (.01 level). The F obtained in analysis of variance did not indicate significant differences in Reading, Social Studies and Mathematics.

TABLE XVII

SUMMARY OF ANALYSIS OF VARIANCE

| Area | Significance |
|---|---|
| Composite achievement | Significant at .10 level |
| Reading | Not significant |
| Literature | Significant at .01 level |
| Language | Significant at .01 level |
| Social Studies | Not significant |
| Mathematics | Not significant |
| Science | Significant at .01 level |

## V. SUMMARY OF T-TESTS

Table XVIII is a summary of the results of t-tests applied to the groups two at a time when analysis of variance had indicated significant differences in mean achievement.

The double-grade group was found to have a significantly higher mean achievement than the single-grade group in the following areas: Composite Achievement, Literature, Language and Science. The double-grade group had a significantly higher mean achievement than the ~~single-~~ mult.-grade group in Composite Achievement, Literature, Language and Science. The double-grade group also had a significantly higher mean achievement than the higher multi-grade group in Literature, Language and Science.

The single-grade group achieved significantly higher results than the lower multi-grade group in Composite Achievement, Literature, Language and Science. No significant differences in mean achievement were found between the higher multi-grade and single-grade groups.

The higher multi-grade group achievement was shown to be higher than the lower multi-grade group in Language and Science, however, the level of significance in both cases was only .10.

In general it might be said that the group achievement from highest to lowest was double-grade nine, single-grade nine, higher multi-grade, lower multi-grade. It should be noted that single-grade and ~~lower~~ higher multi-grade were nearly equal in most cases. Also of significance is the fact that in no instance was lower multi-grade achievement found to be higher than any of the other groups. Equally noteworthy is the fact that the double-grade group achievement was the highest in every case.

# TABLE XVIII

## SUMMARY OF T-TESTS

| Area | SG and DG | SG and LMG | SG and HMG | DG and LMG | DG and HMG | LMG and HMG |
|---|---|---|---|---|---|---|
| Composite | DG higher .10 level | SG higher .05 level | No significant difference | DG higher .01 level | No significant difference | No significant difference |
| Reading | F- test only - Assume no significant differences | | | | | |
| Literature | DG higher .01 level | SG higher .01 level | No significant difference | DG higher .01 level | DG higher .01 level | No significant difference |
| Language | DG higher .05 level | SG higher .01 level | No significant difference | DG higher .01 level | DG higher .01 level | HMG higher .05 level |
| Social Studies | F- test only - Assume no significant differences | | | | | |
| Mathematics | F- test only - Assume no significant differences | | | | | |
| Science | DG higher .05 level | SG higher .01 level | No significant difference | DG higher .01 level | DG higher .01 level | HMG higher .10 level |

# CHAPTER IV

# CONCLUSIONS, INTERPRETATIONS AND SUGGESTIONS FOR FURTHER STUDY

## I. FINDINGS

This study investigated the relationship between Grade IX achievement and class organization as regards numbers of grades per room. Four groups were used for comparison, Group SG or single-grade, Group DG or double-grade, Group LMG or lower multi-grade, and Group HMG or higher multi-grade. These four groups are composed of students who attended schools not situated in towns or cities. Group SG or the single-grade group is composed of students who attended schools where there was one and only one Grade IX room, and no other grades were taught in the same room. Group DG or the double-grade group is made up of students who attended schools where there were two classes of Grade IX students. Group LMG or the lower multi-grade group contains students who were taught in rooms where one or more other lower grades, but not higher grades, were taught. Group HMG or the higher multi-grade group students received instructions in rooms where some high school grades were also taught.

Data on all of the students in each case were collected, and then the mean ability levels were equalized by randomly casting out cases in the single-grade, double-grade and lower multi-grade groups until the mean ability levels equalled that of the higher multi-grade group.

Investigation of achievement was made in seven areas: Composite

Achievement, Reading, Literature, Language, Social Studies, Mathematics and Science. Analysis of variance was used to determine whether there were significant differences in each case. However, analysis of variance only determines whether there are significant differences among the four groups, but does not indicate exactly where the differences lie. Therefore, if the analysis of variance results in a significant F, it is followed by the t-test, applied to the groups taken two at a time, to determine which groups have significantly different means. In the following discussion special note is made when the level of significance is only .10.

## Reading

Analysis of variance of Reading results did not show significant differences in mean achievement. This is not too surprising for two reasons. First of all, the groups were equalized on ability according to the Grade IX Ability Test. This test is largely verbal and thus to a large degree the groups have been equalized on reading as well as on ability. Another factor which probably affects the reading is that reading is not taught as a subject past grade six in Alberta. It may be that by grade nine any differences which may have resulted from instruction have been overcome.

## Literature

The analysis of Literature results shows that Grade IX students from schools having two Grade IX rooms had a significantly higher mean achievement than those students from schools where there was only one grade nine room, as well as students who received instruction in multi-

grade classrooms. Students from single Grade IX rooms also achieved significantly higher than did students taught in rooms where other lower grades were also taught, but not significantly higher than students in whose classrooms some high school grades were also taught. The difference in achievement between the two classifications of multi-grade classrooms was not significant.

## Language

In Language achievement, students' results from schools of two Grade IX rooms were significantly higher than those of the other three classifications. Single-grade achievement was also significantly higher than the achievement of students taught in rooms where lower grades also received instruction but not significantly higher than the achievement of the group which received instruction along with one or more higher grades. The multi-grade group of higher grades achieved significantly higher than did the multi-grade group having lower grades in the same room.

## Social Studies

The analysis of Social Studies results did not produce significant differences. This is very interesting since one would expect the classroom organization and type of instruction to have a considerable effect in this subject. Social Studies would seem to depend considerably upon the teacher's ability and training in that these courses in general may not be as clearly defined or follow the texts as closely as perhaps Mathematics and Science. Thus, a teacher would appear to be a very important factor in that a great deal of discussion and finding material

from various sources would be involved. However, it may be that teachers at this level receive better training for the type of instruction involved in Social Studies teaching than for other courses. It may also be that students in a multi-grade situation may have developed, out of necessity, the ability to work independently which would seem to be very important in Grade Nine Social Studies. Perhaps the two points just discussed may partially explain the lack of significant differences in achievement among the four groups in Social Studies. It would be very valuable to conduct some further research into the problem of finding the most effective classroom organization for Social Studies teaching.

Mathematics

The analysis of Mathematics results did not show significant differences in achievement. This writer does not find this too startling for several reasons. One reason may be that mathematics textbooks tend to be "the course" more than do other textbooks. Because considerable explanation, examples, tests and review exercises are contained in mathematics textbooks, it may be that students can, if they so desire learn mathematics fairly well "on their own." The type of classroom organization and instruction may also be less effective in mathematics because of the nature of the course. Mathematics at this level tends to be less nebulous and more clearly delimited than do other courses. It may be that a student who "knows the textbook" can do comparatively better in mathematics than in other subjects. Another explanation may be that our present mathematics courses stress mechanical procedures more, and understanding less, than do other courses, and as a result

less instruction and guidance is necessary for comparable achievement. Also, it may be that our mathematics teachers are using the textbook as the course and that the exams are patterned closely to the texts.

## Science

In Science, the two-grade nine room classification had a mean achievement significantly higher than did the other three groups. The students from schools where there is one complete grade nine room also achieved significantly higher results than did students from a multi-grade situation containing lower grades. The students receiving instruction in the same room with higher grades also achieved barely significantly (.10 level), higher than students who received instruction in the same room with lower grades. The differences in achievement may be due to differences in amounts of equipment and the background of the teachers.

The present Science Course in grade nine puts considerable emphasis on laboratory type experience, and equipment would therefore seem to be an important factor. Science in grade nine is also a comparatively "academic" course. It seems likely then that a teacher's background and knowledge of science would be important. Multi-grade schools are more likely to occur in more isolated and less well-developed areas where it is probably more difficult to obtain well-qualified staffs because of living conditions, isolation and other factors.

## Composite Achievement

The analysis of composite standings resulted in significant differences in some cases. Students from schools where there were two

Grade IX rooms scored significantly higher than students from schools where there was one complete Grade IX room (.10 level), and also higher than the multi-grade group containing lower grades. The single-grade group from schools having one complete Grade IX room also showed significantly higher results than the multi-grade group with lower grades. The multi-grade group with higher grades was not significantly different from any other group.

## II. DISCUSSION OF DIFFERENCES

One of the more striking findings is that although the lower multi-grade (LMG) group is found to achieve significantly lower than the other three groups, the higher multi-grade (HMG) group achievement is not found to differ significantly from the single-grade (SG) achievement.

It may be that several factors tend to increase the effectiveness of these schools as compared to the lower multi-grade group. Association with older and presumably more mature students may be important, as well as the "listening in" on more advanced courses in similar subject matter fields. Teachers in the higher multi-grade schools probably are in more cases qualified to teach high school than teachers in lower multi-grade schools. This may mean that teachers in higher multi-grade schools are better qualified. Teachers teaching grade nine and high school grades may also be more aware of following courses and thus may emphasize "important" parts of courses to a greater extent than teachers of lower multi-grade schools.

There is also another factor which tends to make it difficult to find significant differences among various types of schools or class

organizations, even though they may exist. It is likely that our ability tests not only measure natural ability but also reflect other things such as competence in reading, oral and written language, general knowledge and background of experience, to mention a few. It also seems reasonable that schools which are doing a better job of educating students would tend to produce students more capable in the areas mentioned and hence more likely to do better on the ability tests. Therefore, when we control for ability we partially nullify the effect of the school because even though the ability levels appear equal, we are possibly comparing students with higher actual ability from less effective schools to students of lower actual ability from more effective schools. The fact that the differences in mean reading achievement are extremely small tend to support this view.

## III. GENERAL CONCLUSIONS

The results of this study seem to justify the following general conclusions.

A. Students taught in schools where there are two Grade IX rooms tend to achieve significantly higher results on Grade IX Departmental Examinations, than do students taught in schools having one grade nine class, and lower and higher multi-grade classrooms.

B. Students who receive instruction in schools where there is one complete Grade IX room tend to achieve better results on the Grade IX Departmental Examinations than do students who are taught in multi-grade rooms where there are also grades lower than Grade IX.

C. Multi-grade students where higher grades are also taught tend

to achieve slightly higher than multi-grade students where lower grades are also taught. The validity of this conclusion is discussed earlier in this chapter.

D. This study, in general, tends to support centralization of schools on the basis of academic achievement at the Grade Nine level since the single-grade (SG) and double-grade (DG) groups did achieve significantly higher results than did the lower multi-grade (LMG) group. However, it should be noted that on the basis of this study, grade nine students taught in the same room as higher grades achieve at approximately the same level as grade nine students taught in a single-grade situation.

## IV. SUGGESTIONS FOR FURTHER STUDY

A. It should be interesting and valuable to investigate the morale, social conditions, school spirit and other social and psychological aspects of various sized schools with varying classroom organization. If smaller schools do not produce as high a level of academic achievement, perhaps they have other advantages which may justify their retention.

B. Comparing the academic achievement of various classifications of schools while controlling other variables such as teacher characteristics, class size, school supplies and facilities, etc., would also be a valuable extension to this study. In this way, it may be possible to determine specifically what factors do affect the level of academic achievement obtained.

C. At present teachers' ratings make up about one-half of the

students' final grading in Grade Nine Social Studies and Science. It should be interesting and perhaps valuable to determine the effect of teachers' marks on students' final standings, classified on the basis of school size or organization. The information could be obtained from Department records. One level of achievement for each student could be determined using teachers' grading. Another level of achievement could be obtained using only departmental results. Differences, if any, between the two ratings could then be examined. In many cases, only a few marks mean the difference between passing or failing, and honors or pass standings. One could then determine how many students pass, fail, or receive honors due to the effect of teachers' gradings in these two subjects rather than on their final examination results. For example, it may be possible to hypothesize that students from smaller school are at an advantage due to over-rating by teachers of those schools.

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# APPENDIX A

# SINGLE-GRADE SG

Acadia Valley
Acme
Airdrie
Alder Flats
Allan Johnstone
Alix
Alliance
Altario
Ardmore
Ashmont
Athabasca

Barhill
Barons
Barnwell
Bashaw
Bawlf
Beaumont
Beaupre
Beisiker
Bellis
Benalto
Bezanson
Big Valley
Bindloss
Blackfalds
Blackie
Blueberry Creek
Bluffton
Bon Accord
Bowden
Boyle
Breton
Brownvield
Bruce
Burdett
Byemoor

Camilla
Canmore
Carbon
Cayley
Chamberlain
Chauvin
Chipman
Clive
Cluny
Clyde
Coalhurst
Cochrane
Colchester
Consort
Coutts
Cowley
Cremona
Crestomere
Crossfield
Cunningham
Czar

Dapp
Darwell
Del Bonita
Derwent
Dewberry
Donalda
Donnelly
Duchess
Duclos
Dunstable

East Coulee
East Rolling Hills
Eaglesham
Eckville
Edberg
Edgerton
Entwhistle
Erskine
Empress
Enchant
Evansburg
Exshaw

Falun
Faust
Fawcett
Foremost
Forestburg
Ft. Assiniboine
Ft. Kent

Galahad
Gem
Gibbons
Girouxville
Glendon
Glenwood
Grassland
Gwynne

Halkirk
Harry Balfour
Hay Lakes
Hays
Heisler
Hill Spring
Hines Creek
Hughendon
Huntsville
Hythe
Hussar

Innisfree
Irma
Iron River

Jenny Lind

Kathryn
Keephills
Killam
Kinuso
Kitchener
Kitscoty

LaGlace
Lake Dell
Lavoy
Legal
Linaria
Linden
Livinstone
Lomond
Longview
Lougheed
Lundbreck

Mackenzie
Mallaig
McNally
Manola
Manyberries
Mecca Glen
Meeting Creek
Millet
Milo
Mirror
Mission Park
Mossleigh

Namao
Newbrook
New Hilda
New Norway
New Sarepta
Niton
Noble Central

Oyen

Paradise Valley
Peers
Pipestone
Plamondon
Pontmain

Radway
Ralston
Red Deer Lake
Rich Valley
Rochester
Rosalind
Rosebrier
Rosedale
Rosemary
Round Hill
Rycroft
Ryley

Satinwood
Schuler
Seba Beach
Sedgewick
Seven Persons
Sexsmith
Sheep Creek
Sifton
Slave Lake
Smith
Springbank
Spruce Grove
Spruce View
Standard
Stirling
Strome
Sylvan Heights

Torrington
Teepee Creek
Therien
Tilley
Trochu

Valhalla
Veteran
Vimy

Wanham
Warburg
Warner
Warspite
Waskateneau
Waverley
Wembley
Westbrook
Willingdon
Wildwood
Winfield
Winterburn
Worsley
Wrentham

## DOUBLE-GRADE DG

Andrew
Ardrossan

Bentley
Berwyn

Caroline
Carstairs
Champion
Chestermere Lake
Clear Vista

David Thompson (Condor)
Delburne
Delia

Elk Point

Gershaw

Holden
Horse Hill

Lamont

Manville
Marwayne
Morrin

New Myrnam

Ridge Valley

Sangudo
Smoky Lake

Thorhild
Thorsby
Turner Valley

Vilna (Sask. Lake)

# LOWER MULTI-GRADE SCHOOLS LMG

Alcomdale
Amisk
Annasheim
Anzac
Assumption
Atlee

Blackfoot
Bodo
Bonanza
Border
Botha
Brant
Buffalo Park
Bullhead Butte
Busby

Cadogan
Calling Lake
Carseland
Caslan
Cereal
Cessford
Cherhill
Cherry Point
Chinook
Church Hill
Clandonald
Clymont
Cobblestone
Conquorville
Cora Lynn
Craigend
Craven

Dalum
Dixonville
Duffield

Elmsworth
Endiang
Etzikom

Faraway
Fairdale
Ferintosh
Fishing Lake
Ft. Chipewyan
Ft. Vermilion
Fullham

Genesee
Great Bend
Greencourt
Govedale

Hesketh
Huxley

Islay

Jarvie
Jean Cote
Jefferson
Jenner

Keg River
Kingman
Kinsella

LaCorey
Lebanon
Level Land
Lindale
Littleport
Lodgepole
Lousana

Miame
Marie Reine
Masinasin
McLaughlin
Merna
Metiskow
Midlandvale
Midnapore
Minburn
Mountain View
Mustus Lake

Nacime
Nampa
New Brigden
New Dayton

Owl River

Paddle Prairie
Paddle River
Peter Pond
Preston

Ranfurley
Rich Lake
Richmond Park
Rivercourse
Rochfort Bridge
Rosedale Colony
Rowley

Saskatchewan
Sayre
Scapa
Severne Creek
Silver Spring
St. Laurent
St. Michael
Suffield
Sunnybrook
Swalwell

Tangent
Tarzan
Tomahawk
Tulliby Lake

Verdant Valley

Wabamun
Woodvale

Youngstown

# HIGHER MULTI-GRADE SCHOOLS HMG

Arrowood

Buffalo Coulee

Colinton
Connorsville

Elmer
Elnora

Gadsby
Grain

Heinsburg
Hemaruka
Hoping

Lafond
Langlois

Meadowview

Neerlandia
Netherby
New Hairy Hill

Perry Vale

Rocky Lane
Rocky Ford

Sheerness
Spedden
Spondin
St. Edouard
St. Lima
Sugden

Turin

Wandering River

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